BELBaR Summay

WP 1 Safety Assessment

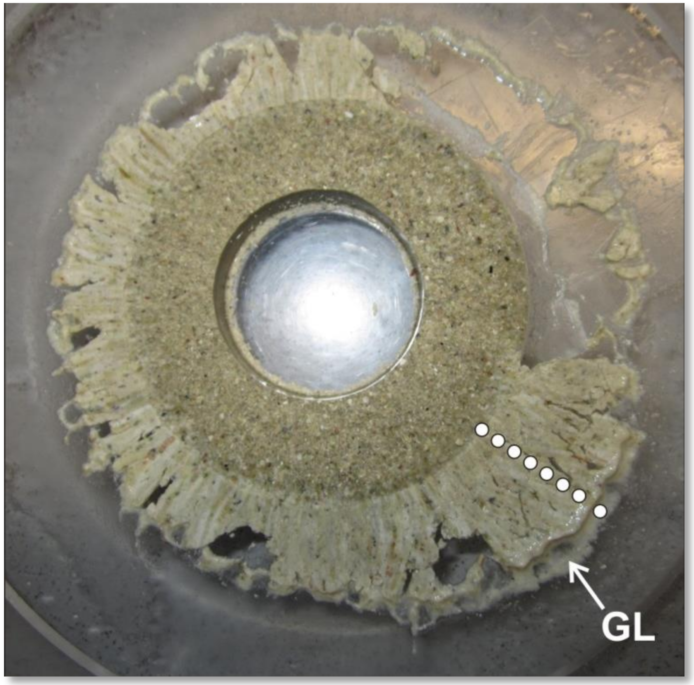
WP1 objectives:

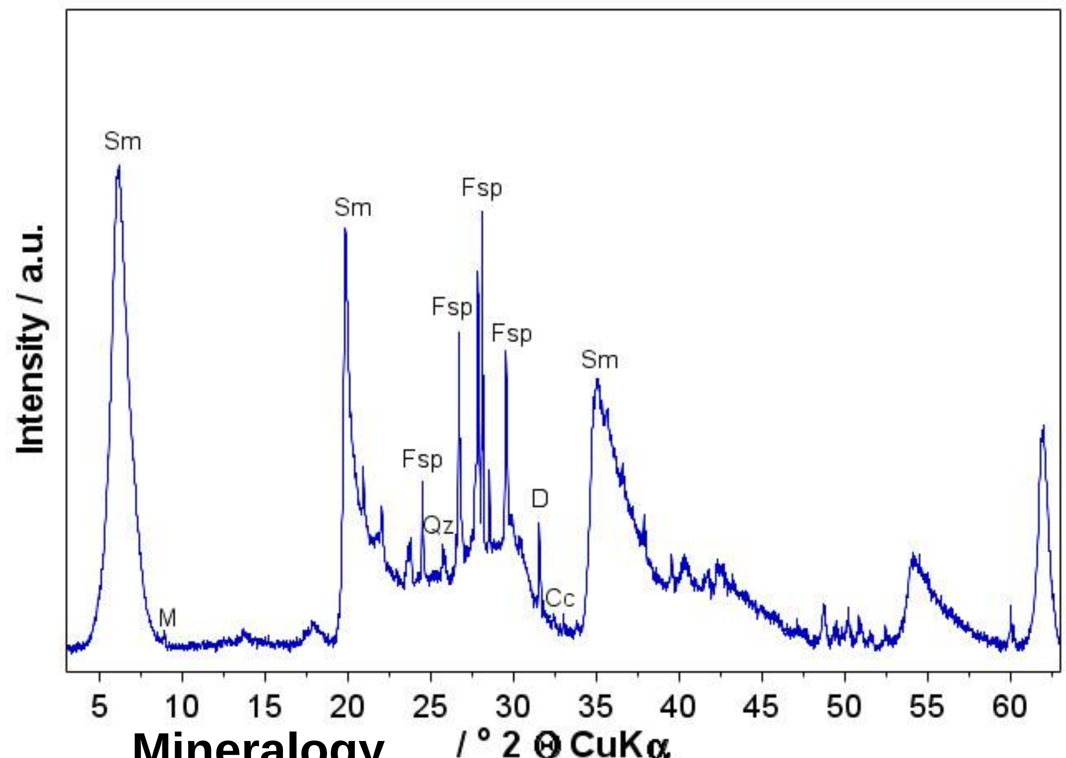
- **Formulate the issues that are important for the long-term safety assessment**
- **Identify the main uncertainties related to colloids in the safety assessment**
- **Provide the focus for the research work in BELBaR**
- **Produce State-of-the-Art Synthesis Report: Colloids and related issues in the long-term safety case**

WP2 Erosion – key objectives

- Mechanisms of clay colloid release
- The role of divalent cations
- The effect of mixed monovalent/divalent systems
- Verification of the dependence between the groundwater velocity and the erosion rate
- The effect of fracture geometry on clay mass loss
- A validated argumentation for (the conditions for) maximum clay mass loss rate to be used in safety case

WP2 Ongoing work - examples





Mineralogy

Smectite (Sm)	80
Mica (Biotite) (M)	2
Quartz (Q)	3
2 Feldspars (Plagioclase, Anorthite) (Fsp)	9
Calcite (Cc)	2
Dolomite (D)	3

Sampling

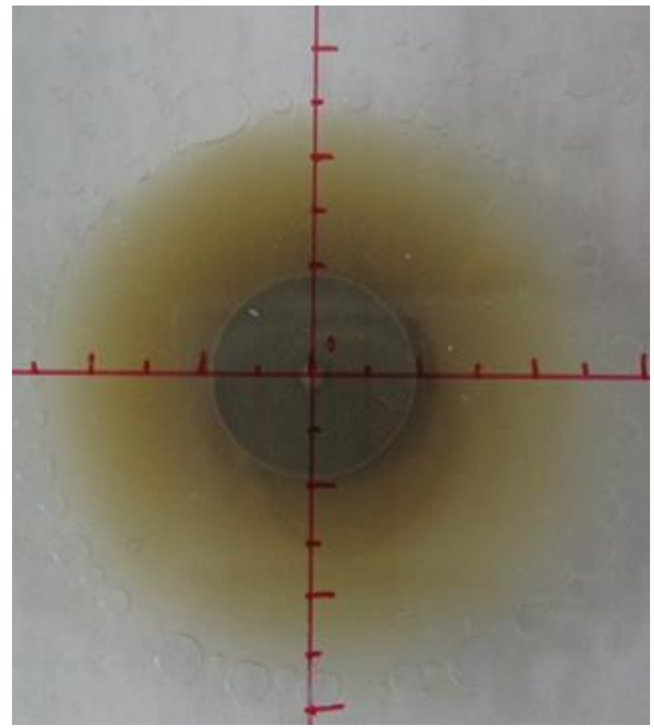
XRD: Sampling line with 7 spots from gel-layer (GL) close to the ring

SEM: Samples of gel-layer, halo and ring

e.g. Caballero et al. (2005) Clay Min., 463.

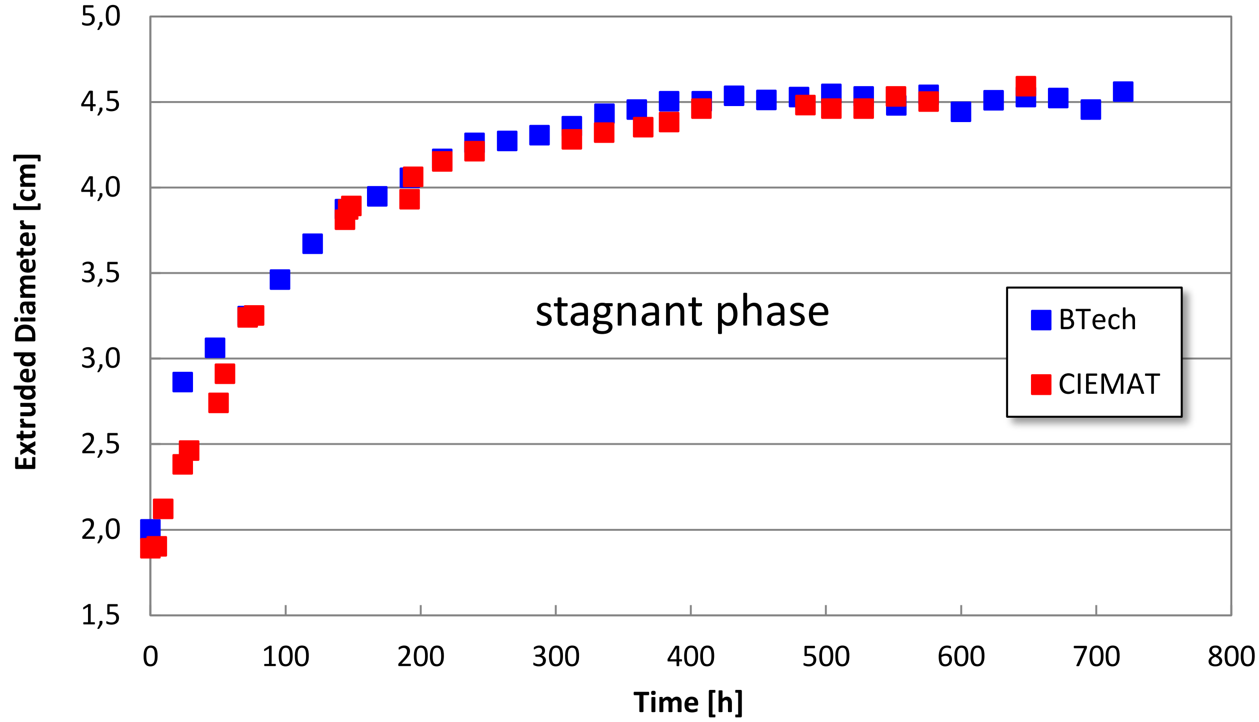
BELBaR Benchmark experiment

B+Tech



Ciemat

BELBaR Benchmark experiment

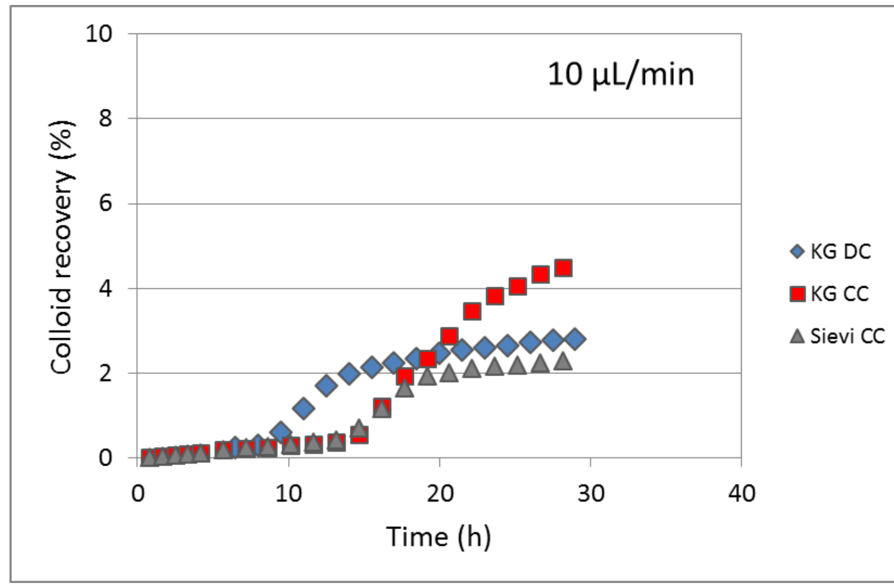


Data comparison

WP3 Radionuclide and host rock interactions – key objectives

- Clay colloids have not been considered radionuclide carriers due to the assumed low contribution
  - Validation or invalidation of this assumption
  - Is there an upper bound for colloid-mediated transport?
- Retardation of colloid transport in the far field, will delay the arrival of radionuclides in the biosphere
  - Safety arguments to support retardation mechanisms
- Is the assumption of reversible, linear sorption of radionuclides onto colloids justified?
-

WP3 Ongoing work - examples

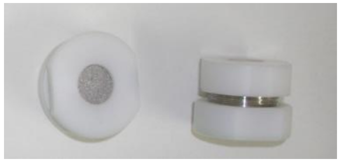


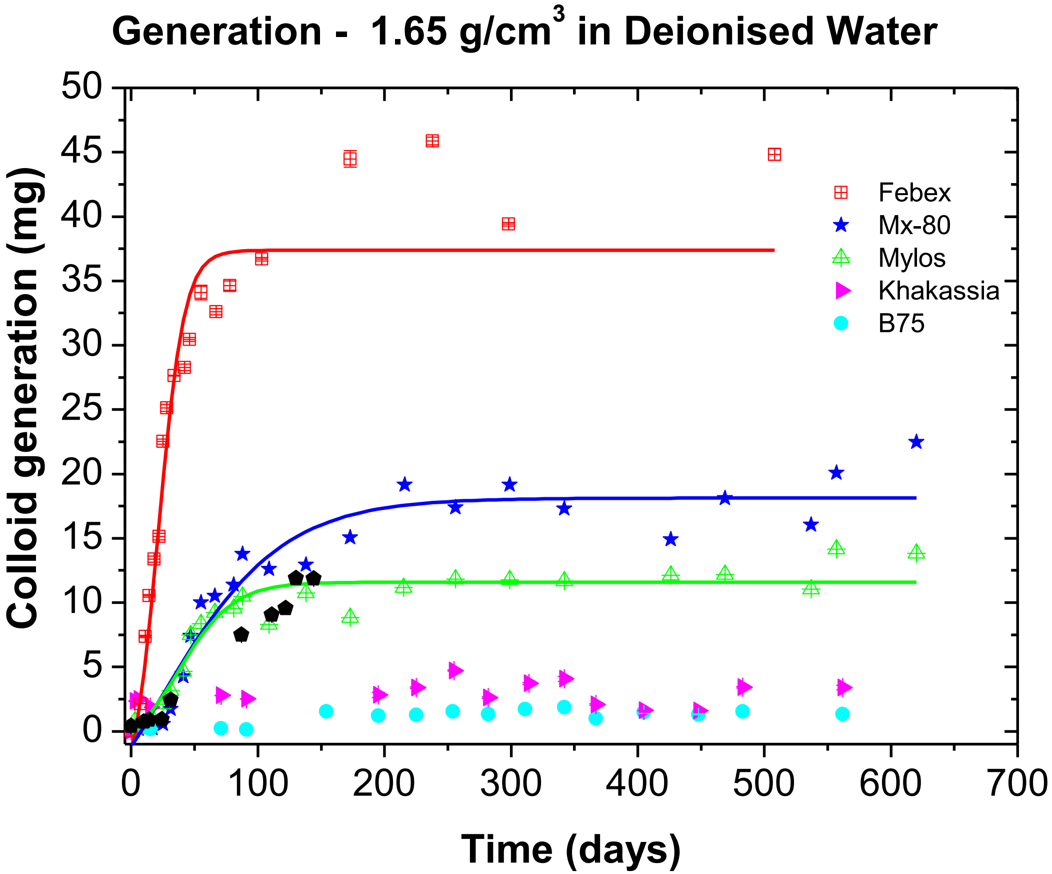
Kuru grey granite drill core column (30 cm) (blue), crushed rock columns (15 cm): Kuru grey (red) and Sievi altered tonalite (grey), flow rate 28 and 10 ul/min, particle size 230 nm

WP4 Colloid stability – key objectives

- The role of divalent cations
- The stability of different bentonites
- The effect of mixed monovalent/divalent systems
- Understanding of the processes controlling colloid stability and their representation in the safety case
- Summary of the influences of these factors on colloid stability, to what extent are they significant for the safety case?

WP4 ongoing work examples





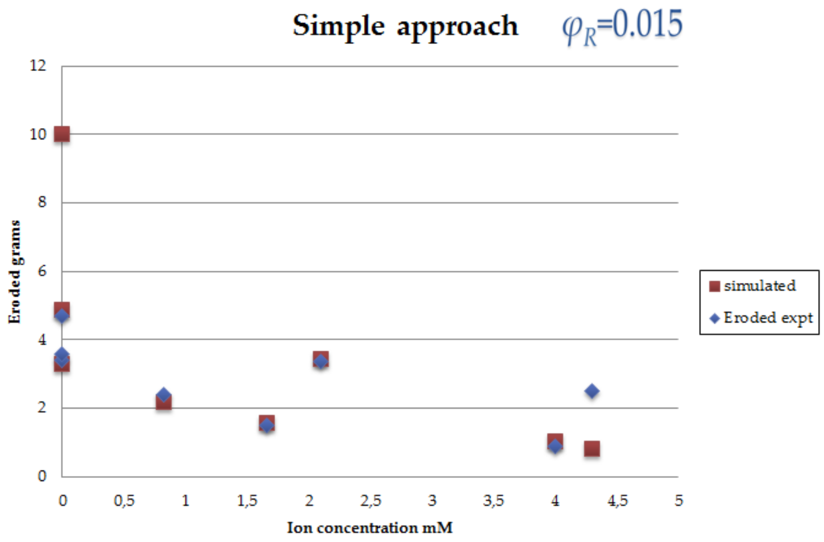
Equilibrium

Different erosion mass

WP5 Conceptual and mathematical models – key objectives

- Improved quantitative models with new data
- Improved conceptual and mathematical models of the influence of colloids on the erosion of the bentonite buffer
- Improved conceptual and mathematical models of colloid-mediated radionuclide transport

WP5 ongoing work - example



Sol viscosity as water
Volume fraction at rim ϕ_R indep. of Ion conc.
Loss rate expression simplifies to

$$N_{rim} = \rho_s \delta_{fr} \phi_R \frac{2}{\sqrt{\pi}} \sqrt{D_R\ x\ u_o}$$

Project status

- ~1 year left
- October 2015 – training course
- November 2015 Scientific synythesis reports
  - Erosion
  - Radionuclide and host rock interactions
  - Colloid stability
  - Conceptual and mathematical models
- February 2016 - Synthesis report of colloids and related issues in the long term safety case
- February 2016 – Final conference

BELBaR Training course

- **When:** **The week of 12-16.October 2015 @KIT-INE**
- 2 days Training course ***„Swelling Clays: From compacted bentonite to clay colloids in the context of nuclear waste disposal“***
  - Max. 20 intern. students (PhD and master students, open to everyone)
  - Lectures given by BELBaR experts on analytics used
  - Invited presentations
  - *Hands-on Training (e.g. LIBD, FFF- ICP-MS, PCS, zeta/streaming potential, ESEM, TRLFS, Synchrotron techniques @ ANKA)*
  - Students poster session
  - Optional: One day field trip (Clay mines, Westerwald region)

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